Pirkey Power Plant
FGD Stackout Area
Alternate Source Demonstration

The Pirkey FGD Stackout Area initiated an assessment monitoring program in accordance with 40 CFR 257.95 on April 3, 2018. Groundwater protection standards (GWPS) were set in accordance with 257.95(d)(2) and a statistical evaluation of the assessment monitoring data was conducted. The statistical evaluation revealed an exceedance of the beryllium and cobalt GWPSs on January 3, 2020. A successful alternate source demonstration (ASD) was completed per 257.95(g)(3), therefore, the Pirkey FGD Stackout Area will remain in assessment monitoring. An alternate source demonstration is documentation that shows a source other than the CCR unit was responsible for causing the statistics to exceed the GWPS. The ASD document will explain the alternate cause of the GWPS exceedance. The successful ASD is attached.

ALTERNATIVE SOURCE DEMONSTRATION REPORT FEDERAL CCR RULE

H.W. Pirkey Power Plant Flue Gas Desulfurization (FGD) Stackout Area Hallsville, Texas

Submitted to

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April 2, 2020

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ATTACHMENTS

LIST OF ACRONYMS

AEP	American Electric Power
ASD	Alternative Source Demonstration
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
EBAP	East Bottom Ash Pond
EPRI	Electric Power Research Institute
FGD	Flue Gas Desulfurization
GSC	Groundwater Stats Consulting, LLC
GWPS	Groundwater Protection Standard
LCL	Lower Confidence Limit
MCL	Maximum Contaminant Level
QA	Quality Assurance
QC	Quality Control
SPLP	Synthetic Precipitation Leaching Profile
SSL	Statistically Significant Level
SU	Standard Unit
TCEQ	Texas Commission on Environmental Quality
UTL	Upper Tolerance Limit
USEPA	United States Environmental Protection Agency
WBAP	West Bottom Ash Pond
XRD	X-Ray Diffraction

SECTION 1

INTRODUCTION AND SUMMARY

The H.W. Pirkey Plant, located in Hallsville, Texas, has four regulated coal combustion residuals (CCR) storage units, including the Flue Gas Desulfurization (FGD) Stackout Area (Figure 1). In August 2019, a semi-annual assessment monitoring event was conducted at the FGD Stackout Area in accordance with 40 CFR 257.95(d)(1). The monitoring data were submitted to Groundwater Stats Consulting, LLC (GSC) for statistical analysis. Groundwater protection standards (GWPSs) were previously established for each Appendix IV parameter in accordance with the statistical analysis plan developed for the unit (AEP, 2017) and United States Environmental Protection Agency's (USEPA) *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance* (Unified Guidance; USEPA, 2009). The GWPS for each parameter was established as the greater of the background concentration and the maximum contaminant level (MCL) or for constituents without an MCL, the risk-based level specified in 40 CFR 257.95(h)(2). To determine background concentrations, an upper tolerance limit (UTL) was calculated using pooled data from the background wells collected during the background monitoring and assessment monitoring events.

Confidence intervals were calculated for Appendix IV parameters at the compliance wells to assess whether these parameters were present at a statistically significant level (SSL) above the GWPSs. Seasonal patterns were observed on the time series plots of beryllium and cobalt in wells AD-22 and AD-7 and for combined radium 226+228 in well AD-7 (Geosyntec, 2020). To correctly account for seasonality, confidence intervals for these wells and constituents were constructed using deseasonalized values. An SSL was concluded if the lower confidence limit (LCL) of a parameter exceeded the GWPS (i.e., if the entire confidence interval exceeded the GWPS). The following SSLs were identified at the Pirkey FGD Stackout Pad:

- The deseasaonalized LCL for beryllium exceeded the GWPS of 0.004 mg/L at AD-7 (0.00603 mg/L) and AD-22 (0.00447 mg/L); and,
- The deseasonalized LCL for cobalt exceeded the GWPS of 0.0560 mg/L at AD-22 (0.0727 mg/L).

No other SSLs were identified (Geosyntec, 2020).

1.1 CCR Rule Requirements

USEPA regulations regarding assessment monitoring programs for CCR landfills and surface impoundments provide owners and operators with the option to make an alternative source demonstration when an SSL is identified (40 CFR 257.95(g)(3)(ii)). An owner or operator may:

> *Demonstrate that a source other than the CCR unit caused the contamination, or that the statistically significant increase resulted from error in sampling,*

> *analysis, statistical evaluation, or natural variation in groundwater quality. Any such demonstration must be supported by a report that includes the factual or evidentiary basis for any conclusions and must be certified to be accurate by a qualified professional engineer or approval from the Participating State Director or approval from EPA where EPA is the permitting authority. If a successful demonstration is made, the owner or operator must continue monitoring in accordance with the assessment monitoring program pursuant to this section….*

Pursuant to 40 CFR 257.95(g)(3)(ii), Geosyntec Consultants, Inc. (Geosyntec) has prepared this Alternative Source Demonstration (ASD) report to document that the SSLs identified for beryllium and cobalt is from a source other than the WBAP.

1.2 Demonstration of Alternative Sources

An evaluation was completed to assess possible alternative sources to which the identified SSL could be attributed. Alternative sources were identified amongst five types, based on methodology provided by EPRI (2017):

- ASD Type I: Sampling Causes;
- ASD Type II: Laboratory Causes;
- ASD Type III: Statistical Evaluation Causes;
- ASD Type IV: Natural Variation; and
- ASD Type V: Alternative Sources.

A demonstration was conducted to show that the SSLs identified for beryllium and cobalt were based on a Type IV cause and not by a release from the Pirkey FGD Stackout Area.

SECTION 2

ALTERNATIVE SOURCE DEMONSTRATION

The Federal CCR Rule allows the owner or operator 90 days from the determination of an SSL to demonstrate that a source other than the CCR unit caused the SSL. The methodology used to evaluate the SSLs identified for beryllium and cobalt and the proposed alternative sources are described below.

2.1 Proposed Alternative Source

An initial review of site geochemistry, site historical data, and laboratory quality assurance/quality control (QA/QC) data did not identify ASDs due to Type I (sampling), Type II (laboratory), or Type III (statistical evaluation) issues. As described below, the SSL has been attributed to natural variation associated with seasonal effects, which is a Type IV (natural variation) issue.

2.1.1 Beryllium

SSLs were identified for beryllium at AD-7 and AD-22 using deseasonalized statistics (Geosyntec, 2020). According to the Unified Guidance, "seasonal correction should be done both to minimize the chance of mistaking a seasonal effect for evidence of contaminated groundwater, and also to build more powerful background to compliance point tests. Problems can arise, for instance, from measurement variations associated with changing recharge rates during different seasons" (USEPA, 2009).

The seasonal effects observed in the statistical analysis occur in roughly annual cycles, with higher beryllium concentrations occurring in early spring and lower concentrations in early fall. For example, beryllium concentrations in 2019 at AD-22 were 0.0133 milligrams per liter (mg/L) in March 2019, in contrast to 0.00338 mg/L in September 2019. A previous ASD for the Stackout Pad showed that beryllium concentrations at AD-22 appear to correlate with groundwater elevations in the well (Geosyntec, 2019a). This relationship still holds true at AD-22 and also appears to be present at AD-7 (Figure 2). Beryllium concentrations at AD-7 and AD-22 are both correlated with seasonal changes in other constituents, including calcium (Figure 3) and lithium (Figure 4). The correlation between beryllium and both monovalent (lithium) and divalent (calcium) cations suggests that the increases in beryllium concentration are related to cation exchange behavior with clay minerals present in the native soil.

Five soil borings (SP-B1 through SP-B5) were advanced in the area of the Stackout Pad in March 2020 to investigate the distribution of clays in the subsurface geology. The soil boring locations are shown on Figure 1. Boring SP-B1 was advanced upgradient of the Stackout Pad to represent unimpacted conditions. SP-B2 and SP-B4 were advanced adjacent to AD-7 and AD-22, respectively, to re-log the geology at each well location. The boring logs are provided in Attachment A.

Generally, clay materials were identified in the seasonally saturated zones above the permanent water table. At AD-7, which was relogged by SP-B2, the depth to water fluctuated between approximately 9 and 15 feet below ground surface (ft bgs), with silty clay present from approximately 2.5-6.9 ft bgs before transitioning to clay until 18.8 ft bgs (Figure 5). At AD-22, which was relogged by SP-B4, the depth to water fluctuated between approximately 3 and 12 ft bgs. Clay was identified from approximately 1.5 ft bgs to 13.3 ft bgs, where it transitioned to a clayey silt (Figure 6).

Soil samples were collected from the seasonal water table and within the screened interval during the re-logging of AD-7 and AD-22 for analysis of mineralogy via X-ray diffraction (XRD). The XRD analysis confirmed the presence of clays within the seasonal water table and sand within the screened interval, as summarized in Table 1. The clay fraction of the uppermost samples collected from within the seasonal water table were further analyzed to identify the type of clays present. Smectite-type clays, which are 2:1-layer clays with significant cation exchange properties, make up the majority of the clay minerals present at those intervals.

Sorption and desorption of beryllium from smectite-type clays is well documented (Boschi and Willenbring, 2016a; You, et al., 1989). Desorption was found to be affected by pH, with 75% of beryllium desorbed from a smectite-type clay as pH changed from 6.0 standard units (SU) to 3.0 SU (Boschi and Willenbring, 2016b). The pH values recorded at AD-7 and AD-22 for samples collected under the Federal CCR Rule ranged from 2.9 to 4.1 SU and 3.9 to 5.1 SU, respectively, suggesting that conditions are favorable for beryllium desorption from smectite-type clays. The presence of these exchangeable clays provides further evidence that the exceedances of beryllium at AD-22 and AD-7 can be attributed to the effects of seasonal groundwater elevation changes, and the resulting cation exchange between groundwater and the exchangeable clay within the seasonal water table, on groundwater quality.

2.1.2 Cobalt

An SSL was identified for cobalt at AD-22 using deseasonalized statistics (Geosyntec, 2020). Similar to beryllium, the cobalt concentrations at AD-22 appear to correlate with seasonal changes in groundwater elevation (Figure 7). The cobalt concentrations are also well correlated with changes in other cations, including calcium and lithium (Figure 8). The concentration ratio between cobalt and calcium is consistent at both upgradient and downgradient locations (Figure 9), suggesting that the cobalt can be attributed to a natural mechanism which is consistent across the site.

While the seasonal increase in beryllium was attributed to desorption from smectite-type clay minerals, cobalt sorption to clay fractions is not favorable. However, cobalt is known to readily adsorb to iron oxides (Borggaard, 1987; McLaren, et al., 1986). Both the boring log for SP-B4, which was advanced to re-log AD-22 (Attachment A), and the original boring log for AD-22 (Attachment B) indicate the presence of iron ore material in the aquifer solids. Additionally, XRD analysis confirmed the presence of goethite, a pure iron oxide (FeOOH), present at low concentrations both within the seasonal water table and the screened interval at AD-22 (Table 1).

The presence of well-defined goethite suggests amorphous iron oxides are also likely present within these soils and provide reactive cation exchange sites with cobalt. These amorphous iron oxides, while likely present, are not easily identifiable with XRD, due to the non-crystalline nature of these iron phases. Seasonal increases in cobalt concentrations are likely associated with greater contact between groundwater and these iron oxides as the water table rises and saturates more of the aquifer solids.

While goethite was identified in the seasonally saturated zone, siderite and pyrite, both reduced iron-bearing minerals, were identified deeper, within the saturated screened interval at AD-22 (Table 1). The weathering of siderite and pyrite to goethite under oxidizing conditions is a well-understood phenomenon, including in formations in east Texas (Senkayi, et al., 1986; Dixon, et al., 1982). A review of geochemical conditions at AD-22 shows that pyrite and goethite are both able to form under different conditions, with recent conditions favoring goethite (Figure 10). Cobalt is known to substitute for iron in both siderite and pyrite due to their similar ionic radii (Gross, 1965; Hitzman, et al., 2017; Krupka and Serne, 2002). The proposed substitution of cobalt for iron in the crystal lattice of pyrite has been documented in other ASDs prepared for the Pirkey Plant's East Bottom Ash Pond (EBAP; Geosyntec, 2019b) and West Bottom Ash Pond (WBAP; Geosyntec, 2019c). The contribution of cobalt to groundwater via dissolution of siderite or pyrite is not likely to change seasonally, as they are present within the screened interval where the aquifer materials are continuously saturated.

As described above, the ratio between the observed calcium and concentrations is consistently on the order of 100:1 at all groundwater monitoring wells in the network (Figure 9). A sample was collected of the solid FGD sludge material which is accumulated on the Stackout Pad. The solid phase sample was leached using both USEPA's Synthetic Precipitation Leaching Profile (SPLP) testing procedure (SW-846 Test Method 1312) and Texas Commission on Environmental Quality's (TCEQ's) 7-Day Distilled Water Leachate Test Procedure (30 TAC Chapter 335 Subchapter R Appendix 4). While cobalt concentrations in both of the leached samples are consistent with those observed in the groundwater samples, the leached calcium concentrations are approximately two to three orders of magnitude higher. However, calcium concentrations in groundwater are generally consistent between AD-22 and upgradient well AD-13 (Figure 11). The different ratio between calcium and cobalt in the leached FGD sludge material (about 45,000:1) as compared to the ratio for groundwater partnered with the similarity between upgradient and downgradient calcium concentrations provide additional lines of evidence that the exceedances observed at the FGD Stackout Pad are not due to a release from the unit.

2.1.3 Conceptual Site Model

The seasonal fluctuations in beryllium concentrations at AD-7 and AD-22 and cobalt at AD-22 can be attributed to variations in the amount of the aquifer solids that are in contact with groundwater as the water table elevation changes. When the water table is higher, more clay material is in contact with groundwater, allowing greater desorption of cations (including beryllium) from the cation exchange sites on the clay. In the case of cobalt, more iron oxides are in contact with groundwater as the water table rises, allowing greater desorption from both amorphous and mineral phases. Thus, the observed SSLs were attributed to natural variation associated with seasonal desorption of beryllium and cobalt as the amount of aquifer solids that are saturated increases.

2.2 Sampling Requirements

As the ASD described above supports the position that the identified SSLs are not due to a release from the Pirkey FGD Stackout Area, the unit will remain in the assessment monitoring program. Groundwater at the unit will continue to be sampled for Appendix IV parameters on a semi-annual basis.

SECTION 3

CONCLUSIONS AND RECOMMENDATIONS

The preceding information serves as the ASD prepared in accordance with 40 CFR 257.95(g)(3)(ii) and supports the position that the SSLs of beryllium at AD-7 and AD-22 and the SSL of cobalt at AD-22 identified during assessment monitoring in August 2019 were not due to a release from the FGD Stackout Area. The identified SSLs were, instead, attributed to natural variation related to seasonal desorption of beryllium and cobalt from the aquifer solids. Therefore, no further action is warranted, and the Pirkey FGD Stackout Area will remain in the assessment monitoring program. Certification of this ASD by a qualified professional engineer is provided in Attachment C.

SECTION 4

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TABLES

Table 1: X-Ray Diffraction Results
FGD Stackout Pad - H. W. Pirkey Plant

Boring Location	**SP-B2**			**SP-B4**		
Associated Well	**AD-7**			**AD-22**		
Depth (ft bgs)	**10-12**	**16-18**	**27-29**	**6-8**	**18-20**	**22-24**
Sample Location	**Within Seasonal Water Table**	**Below Seasonal Water Table**	**Within Screened Interval**	**Within Seasonal Water Table**	**Below Seasonal Water Table**	**Within Screened Interval**
Quartz	39	37	79	28	47.5	95
Plagioclase Feldspar	-	1	-	<0.5	<0.5	1
K-Feldspar	<0.5	1	-	1	0.5	-
Goethite	1	2	0.5	1	-	2
Hematite	-	-	0.5	-	-	-
Chlorite	-	-	-	1	-	-
Siderite		-			10	-
Pyrite	-	-	-	-	2	-
Clays	*	59	20	*	40	2
Kaolinite	9			13		
Illite/Mica	1			2		
Smectite	50			43		
Mixed-Layered Illite/Smectite	-			11		

Notes:

-: not detected

Mineral constituents are reported in percentage.

Values shown as less than indicate the mineral constituent is present but below the quantification limit.

*The clay fraction at SP-B2-10-12 and SP-B4-6-8 were further analyzed to characterize the types of clays present, as listed below.

FIGURES

Legend

⊕ Downgradient Monitoring Well

⊕ Upgradient Monitoring Well

⊕ 2020 Soil Borings

▭ Stackout Pad

Notes

- Soil boring locations are approximate.
- Monitoring well locations are provided by AEP.

500 250 0 500 Feet

March 2020 Soil Borings

AEP Pirkey Power Plant
Hallsville, Texas

Geosyntec consultants

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Figure

1

Columbus, Ohio

2020/03/27

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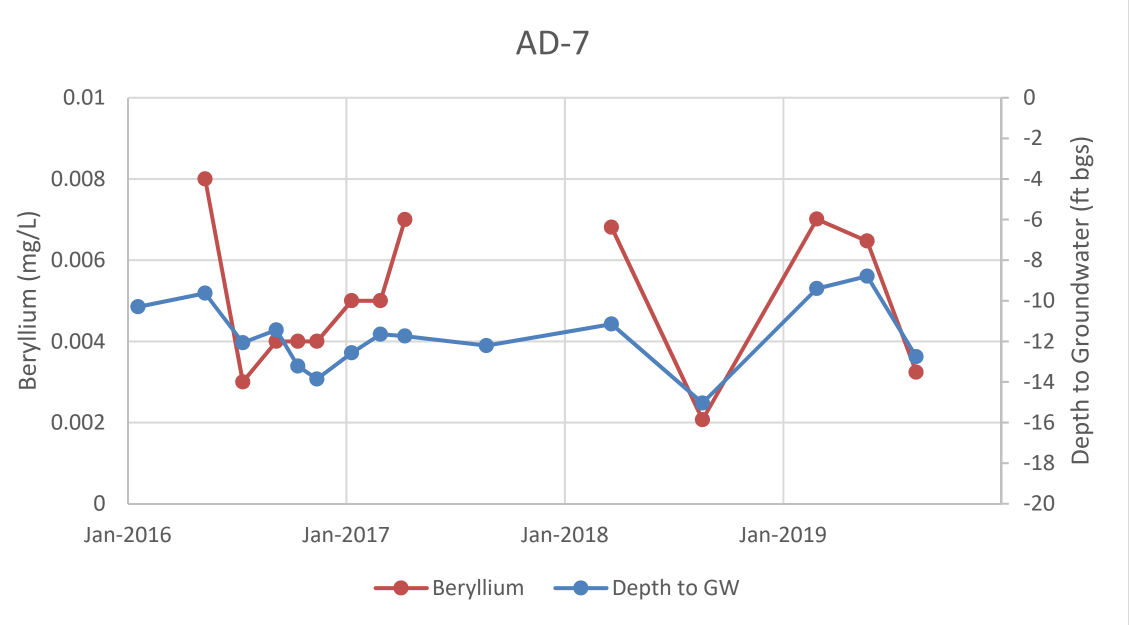

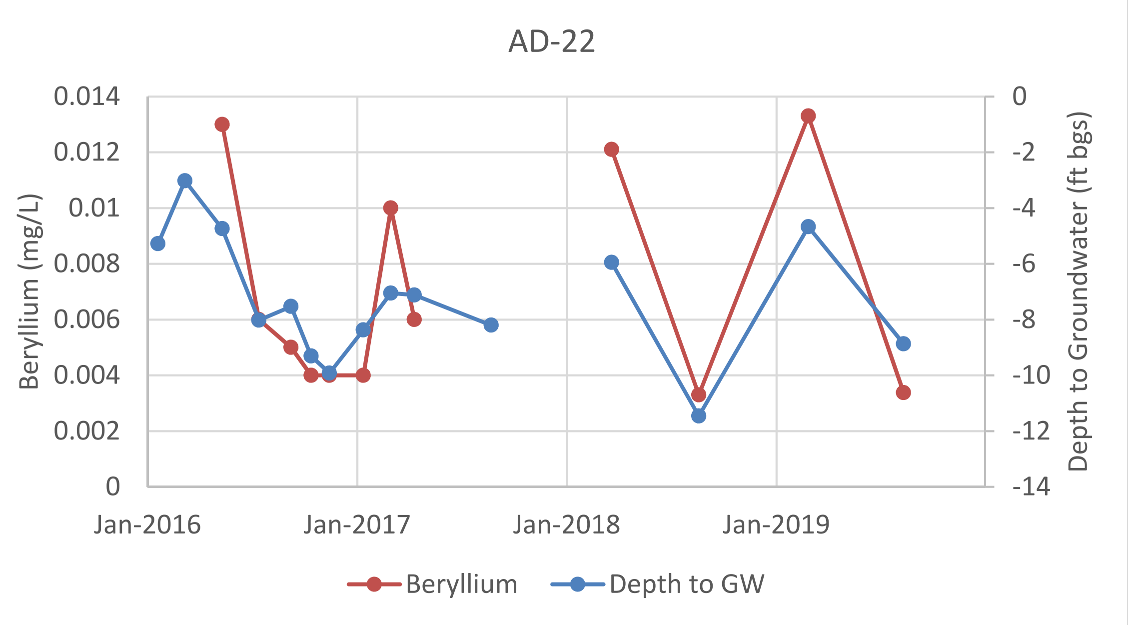

Notes: Beryllium concentrations are shown in milligrams per liter (mg/L). Depth to water is shown as feet below ground surface (ft bgs). The gap in beryllium data represents the time period in which detection monitoring took place and samples were not analyzed for beryllium.

Beryllium v. Depth to Groundwater

Pirkey FGD Stackout Pad

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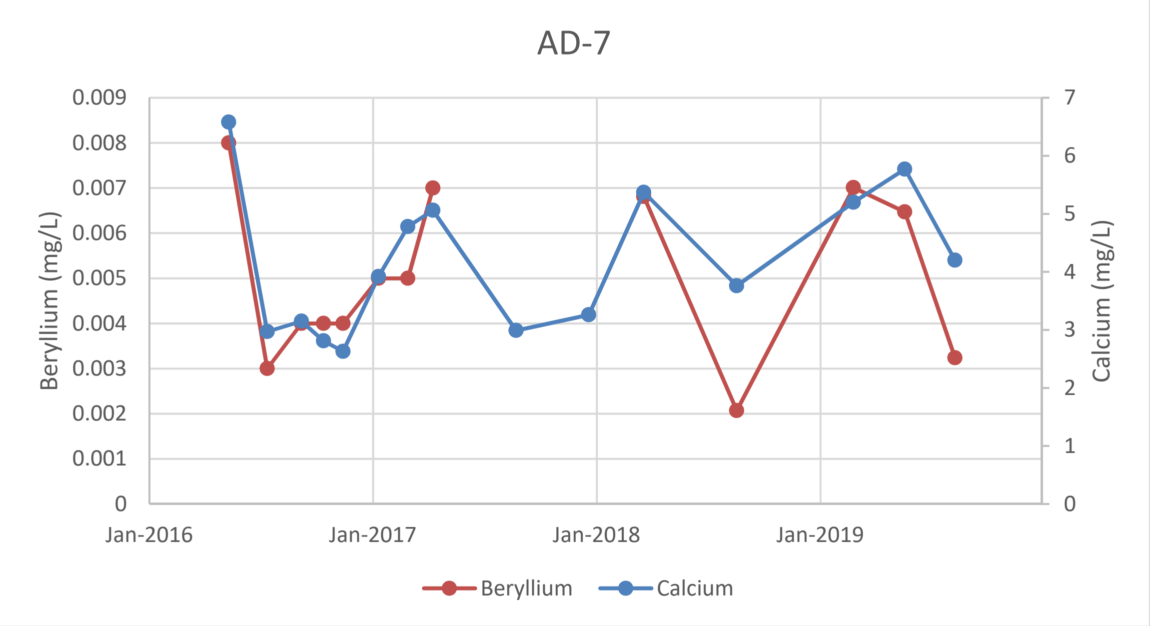
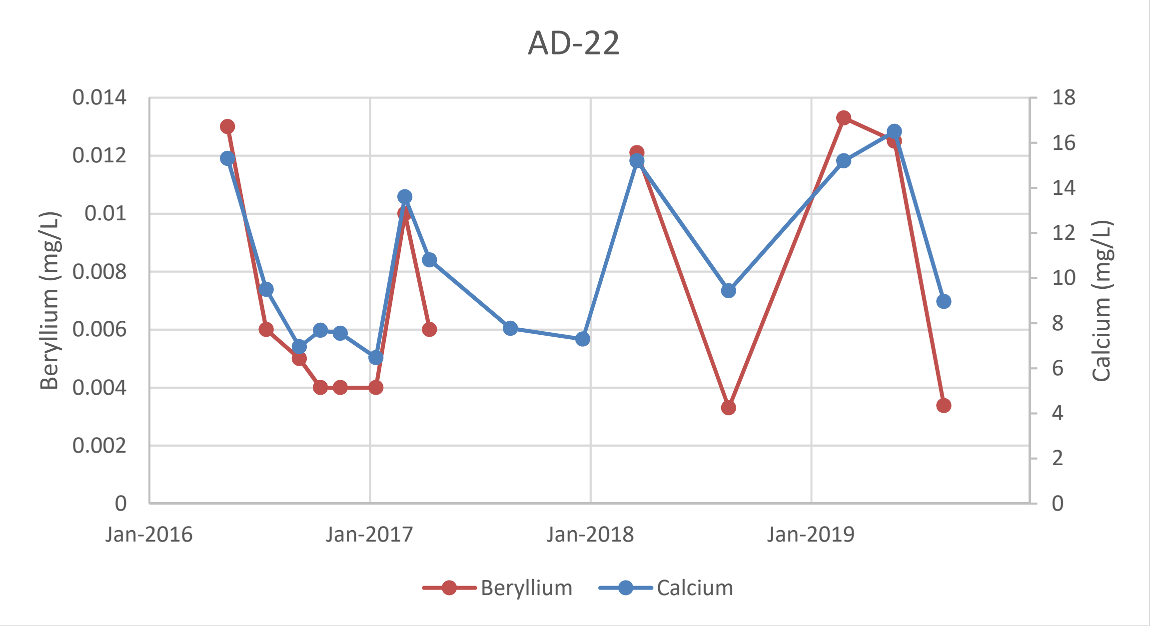
Columbus, Ohio

12-Mar-2020

Figure

2


AD-7


AD-22

Notes: Beryllium and calcium concentrations are shown in milligrams per liter (mg/L). The gaps in beryllium data represent the time period in which detection monitoring took place and samples were not analyzed for beryllium.

Beryllium v. Calcium Concentrations
Pirkey FGD Stackout Pad

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09-Mar-2020

Figure

3

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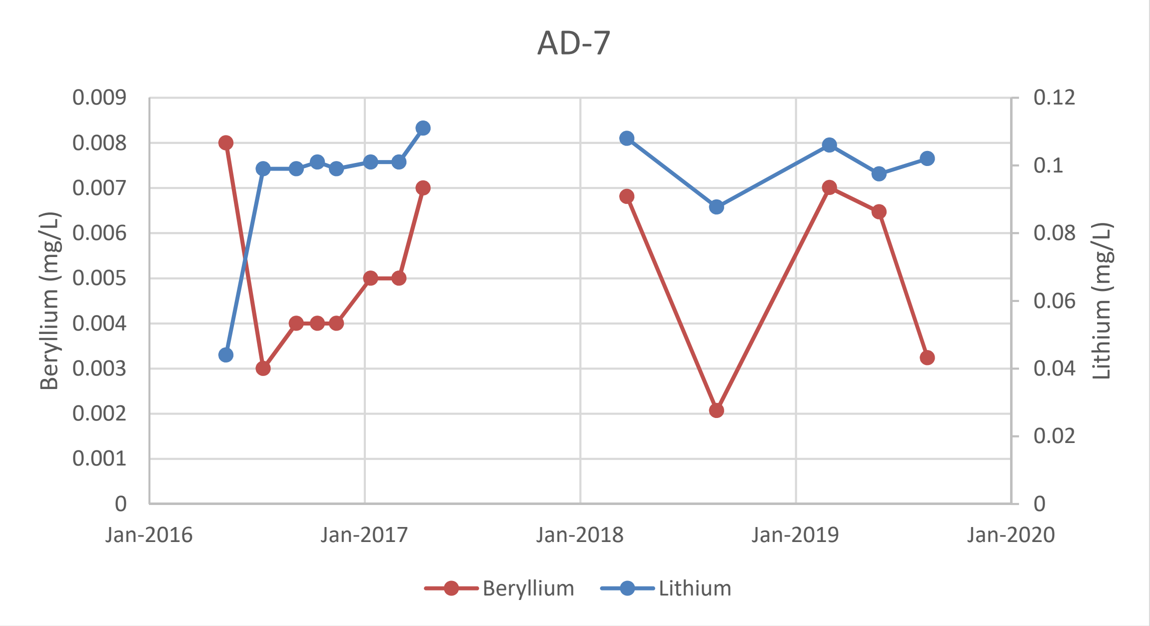

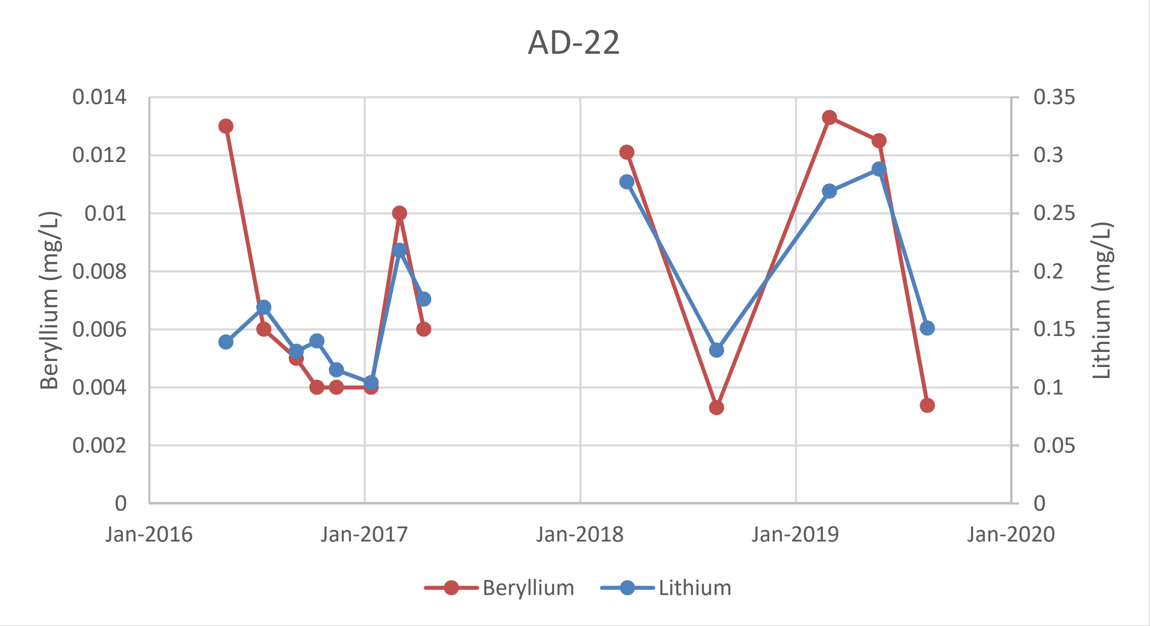

Notes: Beryllium and lithium concentrations are shown in milligrams per liter (mg/L). The gaps in data represents the time period in which detection monitoring took place and samples were not analyzed for beryllium or lithium.

Beryllium v. Lithium Concentrations
Pirkey FGD Stackout Pad

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09-Mar-2020

Figure

4

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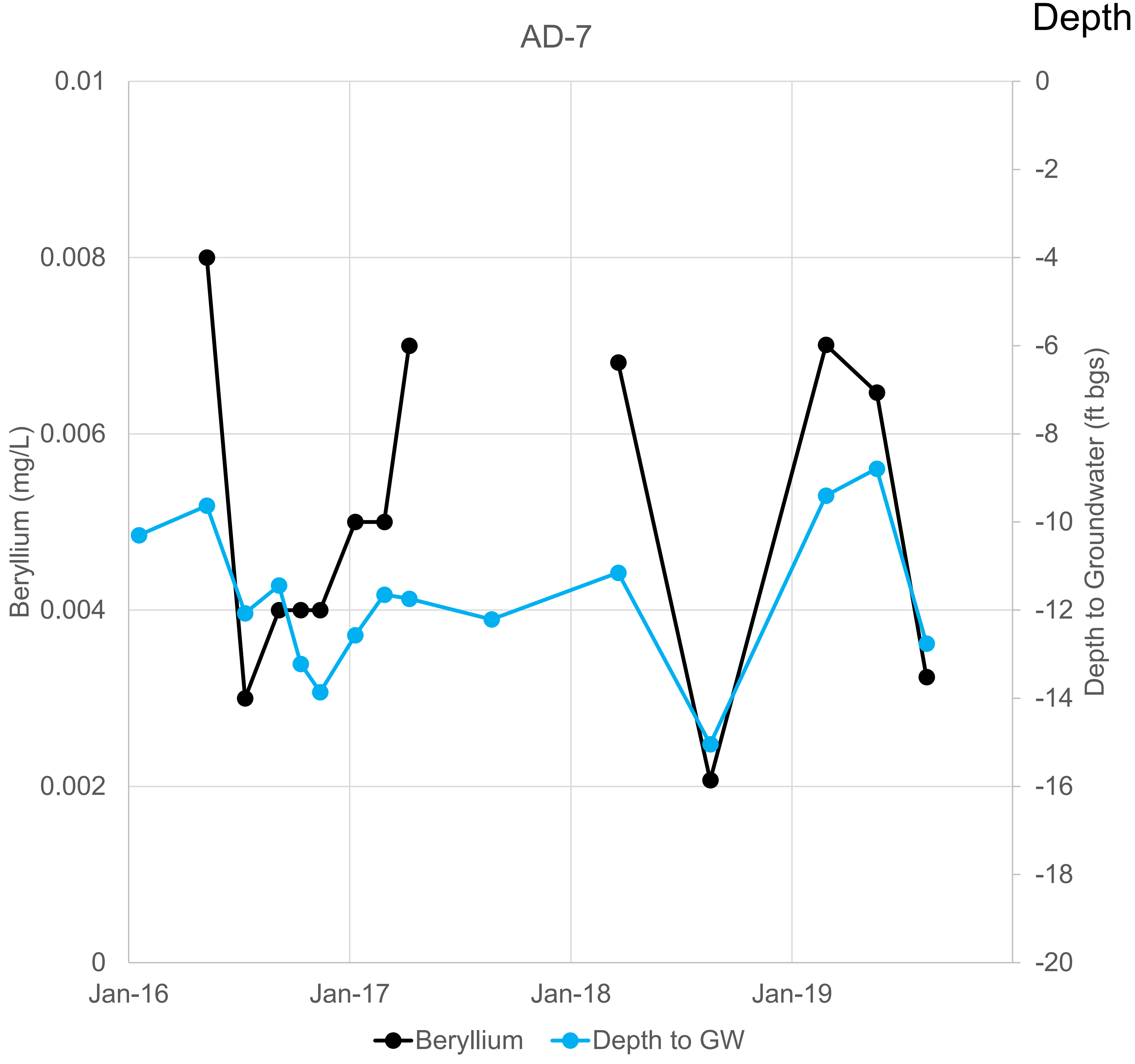

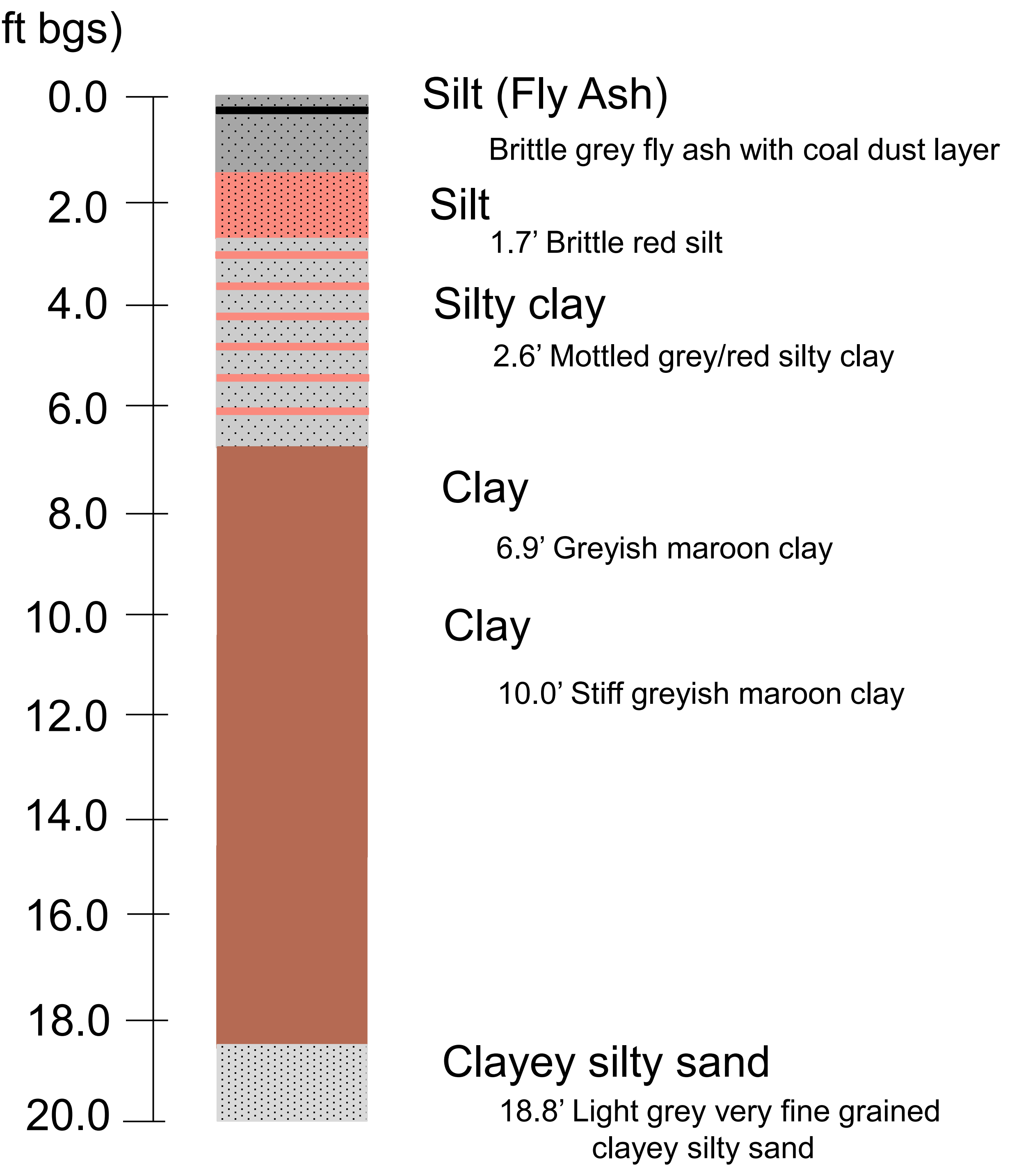

Notes:
- AD-7 was re-logged with SP-B2
-A sample was collected for analysis of mineralogy from 10-12 ft bgs.
-The full boring log is available in Attachment A.

Internal info: Path, date revised, author

AD-7 Seasonal Water Table Geology

Pirkey FGD Stackout Pad

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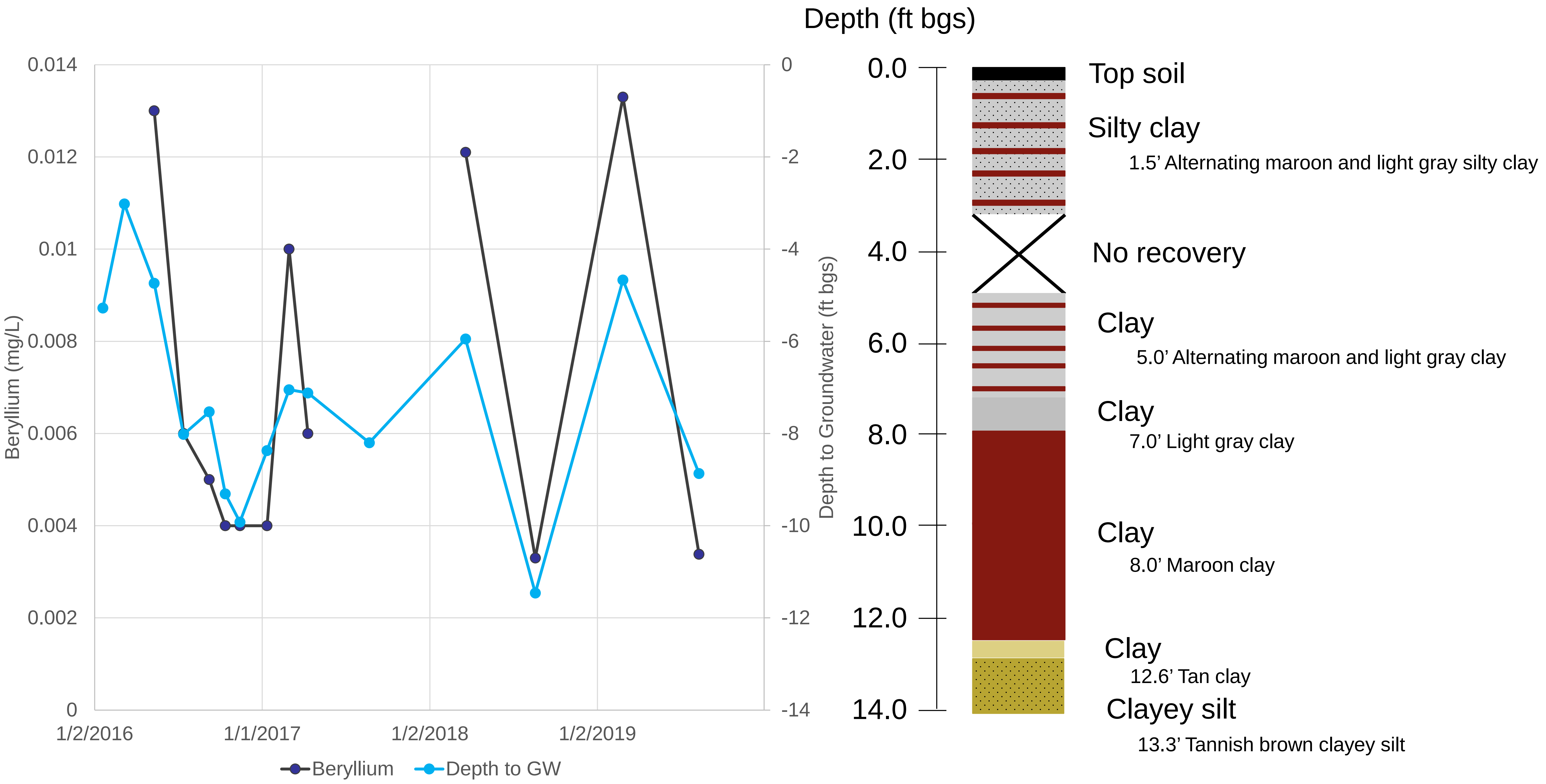
Figure

5

Columbus, OH

13-Mar-2020



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Notes:
-AD-22 was re-logged with SP-B4
-A sample was collected for analysis of mineralogy from 6-8 ft bgs.
-The full boring log is available in Attachment A.

AD-22 Seasonal Water Table Geology

Pirkey FGD Stackout Pad

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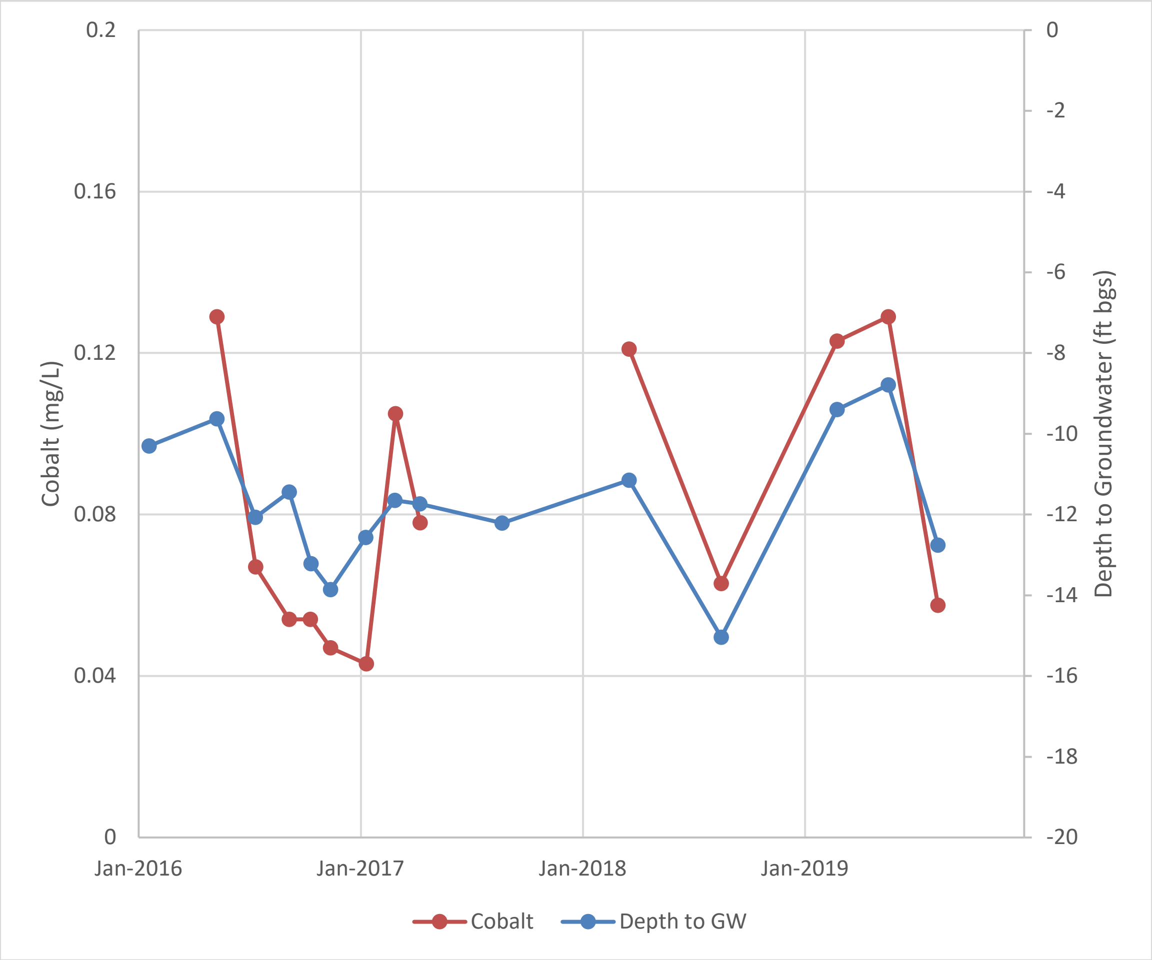
Figure
6

Columbus, OH

13-Mar-2020



Notes: Cobalt concentrations are shown in milligrams per liter (mg/L). Depth to water is shown as feet below ground surface (ft bgs). The gap in cobalt data represents the time period in which detection monitoring took place and samples were not analyzed for cobalt.

AD-22 Cobalt v. Depth to Groundwater

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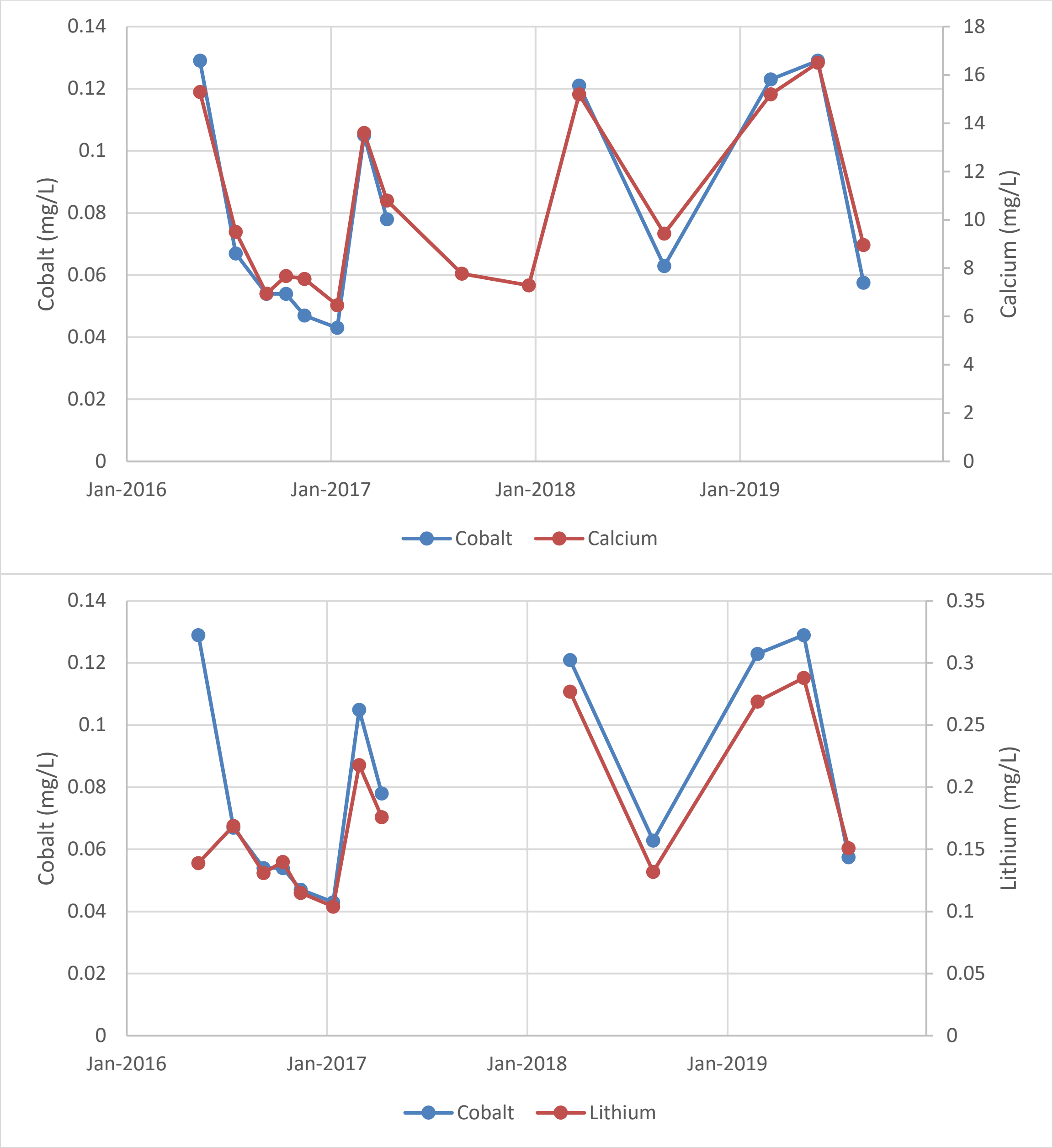
12-Mar-2020

Figure

7



Notes: Cobalt, calcium, and lithium concentrations are shown in milligrams per liter (mg/L). The gaps in cobalt and lithium data represent the time period during which detection monitoring took place and samples were not analyzed for cobalt and lithium.

AD-22 Cobalt v. Calcium and Lithium

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Figure

8

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09-Mar-2020

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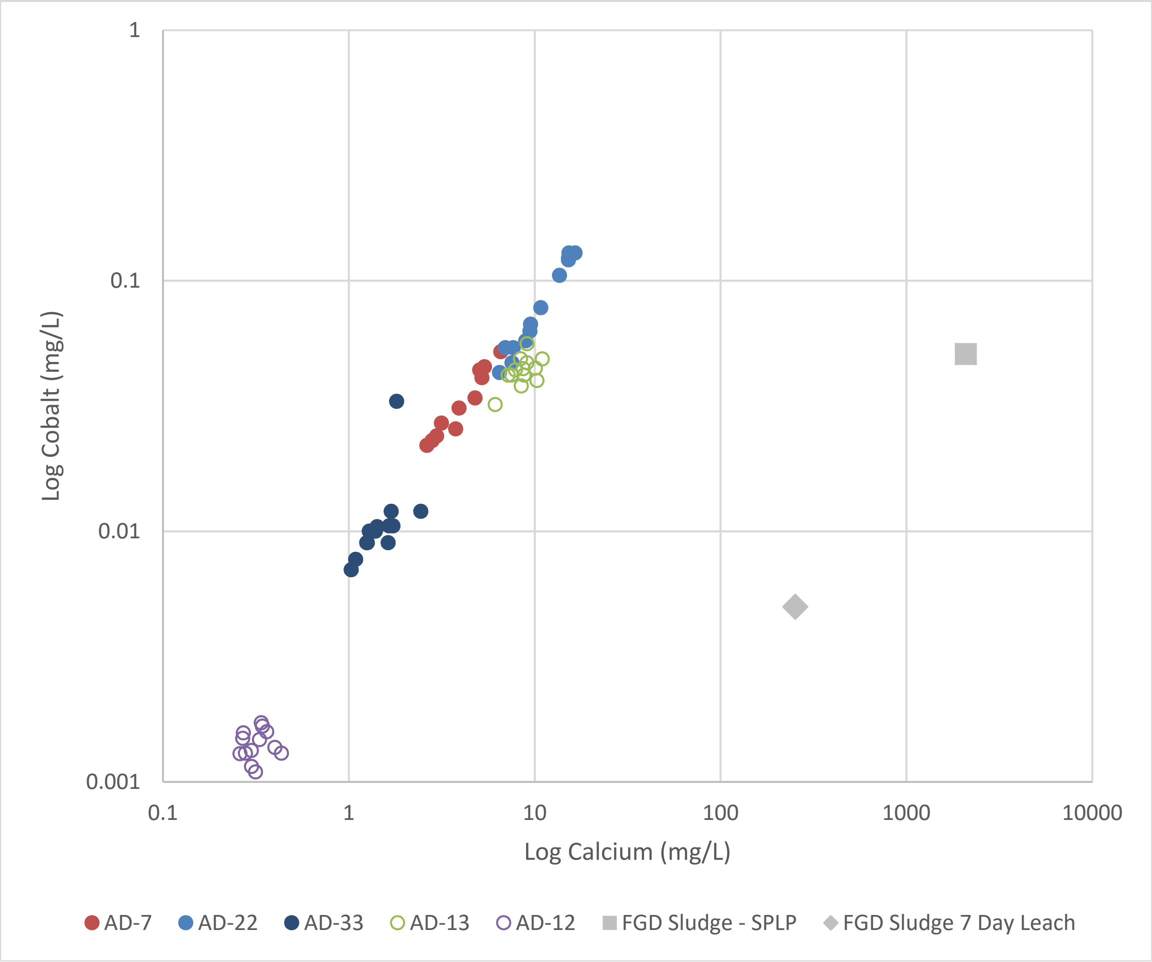

Notes: Cobalt and calcium concentrations are shown in milligrams per liter (mg/L). Upgradient wells are shown with hollow circles. 'FGD Sludge-SPLP' and 'FGD Sludge 7 Day Leach' present the leached concentrations of cobalt and calcium using the Synthetic Precipitation Leaching Procedure (SW-846 Test Method 1312) and the 7-Day Distilled Water Leachate Test Procedure (30 TAC Chapter 335 R4), respectively.

Cobalt and Calcium Concentration Distribution

Pirkey FGD Stackout Pad

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Figure

9

Columbus, Ohio

12-Mar-2020

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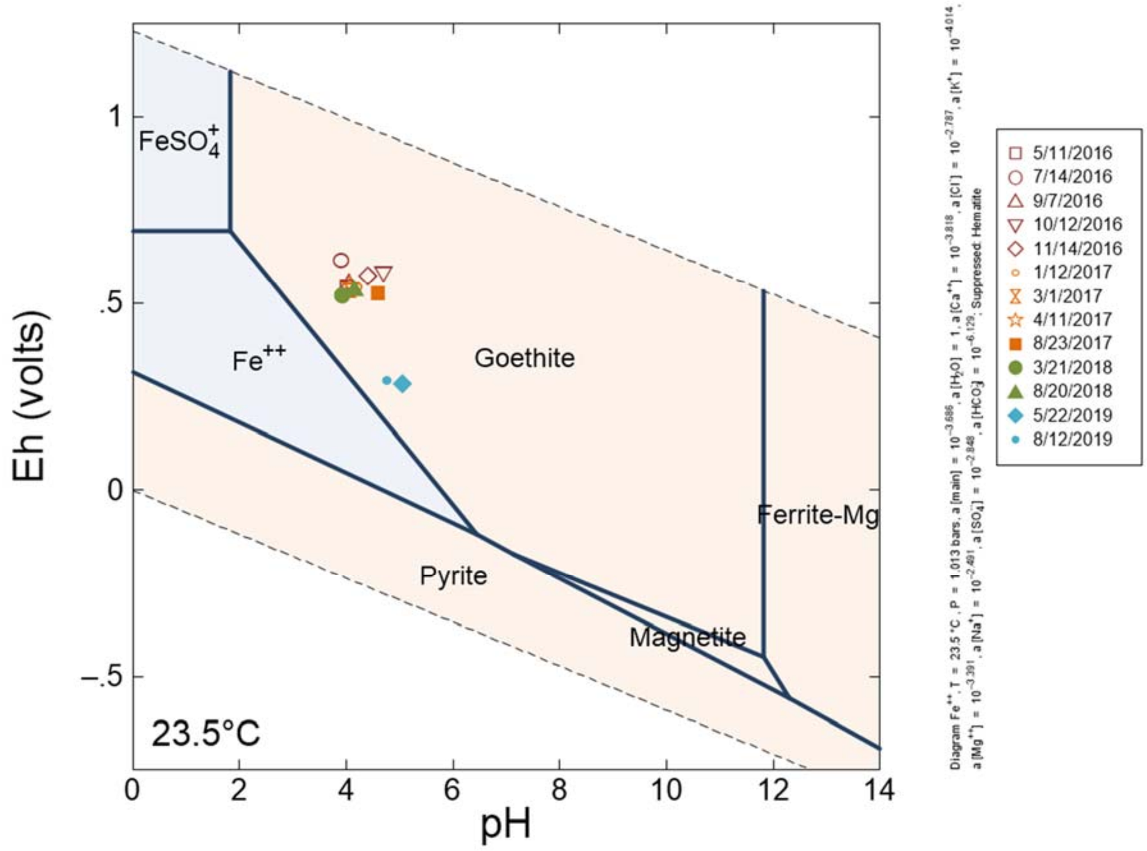

Notes: Average groundwater concentrations of major cations and anions were used to establish baseline conditions for the diagram. Eh and pH values for sampling dates at AD-22 are shown on the diagram.

AD-22 Eh-pH Diagram

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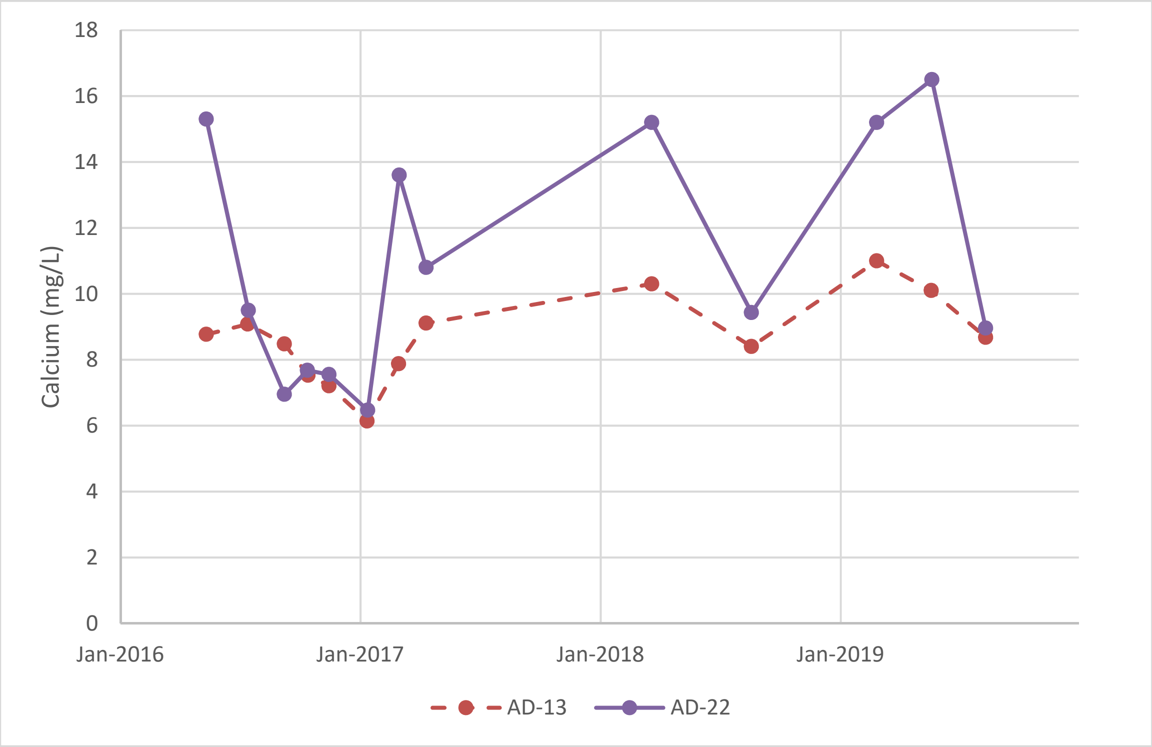
Figure

10

Columbus, Ohio

24-Mar-2020



Notes: Calcium concentrations are shown in milligrams per liter (mg/L). AD-13 is shown with a dashed line because it is an upgradient location.

Calcium Time Series Graph

Pirkey FGD Stackout Pad

Geosyntec consultants

AMERICAN ELECTRIC POWER

Columbus, Ohio

30-Mar-2020

Figure

11

ATTACHMENT A

March 2020 Boring Logs

Soil Boring Log

Project: AEP Pirkey

Boring/Well Name:______ SP-B1

Project Location:____ Hallsville, TX

Boring Date:__ 3/2/2020

Depth Scale Feet	Water Table	Soil Profile Description		PID*
		pp= pocket penetrometer		
0		0.0'-0.4':	Top soil with vegetation, black silt	
		0.4'-2.1':	Brown silt, fine grained, little cohesion, dry	
		2.1'-4.3':	Light maroon and gray clay, low plasticity, moderate stiffness (pp. 3.5); light brown silt/iron ore	
		4.3'-10.0':	Maroon clay, low plasticity, high stiffness (pp. 4.0-5.0), iron ore (brown/red silt pockets throughout), moist at 8.5'	
5				
10	▽	10.0'-15.0':	Dark maroon clay, wet, moderate plasticity, moderate stiffness (pp. 2.5-3.0), red/brown silt pockets (iron ore)	
15		15.0'-15.5':	Dark maroon and red/brown clayey silt; low cohesion; wet	
		15.5'-20.0':	Light gray and red/brown clayey silt, wet, low cohesion, iron ore present	
20		20.0'-21.8':	Dark maroon and red/brown clayey silt; good cohesion; wet	
		21.8'-24.0':	Black silty clay, high stiffness (pp. >5.0), low plasticity	
		24.0'-24.5':	Black silty clay, low stiffness (pp. 2.0), moderate plasticity	
25		24.5'-30.0':	Dark gray/dark green fine grained sand, well sorted, trace silt; wet	
30			Samples collected at 10-12'; 16-18'; 27-29' TD at 30' bgs *PID readings not collected	
35				

Drill Rig Geoprobe 7822 DT

Drilling Contractor:___ Best Drilling

Driller:_ Ramon Gutierrez

Geosyntec Consultants

Soil Boring Log

Project: AEP Pirkey

Boring/Well Name:______ SP-B2

Project Location:____ Hallsville, TX

Boring Date:__ 3/2/2020

Soil Profile

Depth Scale Feet	Water Table	Description		PID*
		pp= pocket penetrometer		
0		0.0'-0.2':	Gray silt, dry, brittle (fly ash)	
		0.2'-0.4':	Black, coal dust, strong odor	
		0.4'-1.7':	Gray silt, dry, brittle (fly ash)	
		1.7'-2.6':	red silt, brittle, dry	
		2.6'-6.5':	Gray and red silty clay, high stiffness (pp. 4.0-5.0), low plasticity, iron ore/mottling present	
5		6.5'-6.9':	Light gray, red and tan clay, low stiffness (pp. 1.5), moderate plasticity	
		6.9'-10.0':	Light gray and maroon clay, moderate stiffness (pp. 3.5), low plasticity, iron ore/mottling present; moist near 9'	
10	▼	10.0'-15.0':	Light gray and maroon clay, moderate/high stiffness (pp. 3.5-4.5), low plasticity, iron ore/mottling present; wet	
15		15.0'-18.5':	Maroon and light gray clay, moderate/high stiffness (pp. 3.0-4.0), low plasticity; wet	
		18.5'-18.8':	Red/brown silt, trace clay, good cohesion	
		18.8'-20.5':	Light gray clayey silty sand, very fine grained, moderate sorting, mottling present; wet	
20		20.5'-23.4':	Light gray and orange clayey silty sand, very fine grained; mottling present, moderate sorting; wet	
		23.4'-25.0':	Maroon and orange silty clay, low stiffness (pp. 0.5), high plasticity; wet	
25		25.0'-29.0':	Same as above; interchanging between silty clay and clayey silt throughout interval, iron ore/mottling present throughout	
		29.0'-29.5':	Black clay, moderate stiffness (pp.3.0), low plasticity	
		29.5'-30.0':	Gray fine grained sand, well sorted; wet	
30			Samples collected at 10-12'; 16-18'; 27-29'	
			TD at 30' bgs	
			*PID readings not collected	
35				

Drill Rig Geoprobe 3230 DT

Drilling Contractor:___ C&S

Driller:_ DJ Diduch

Geosyntec Consultants

Soil Boring Log

Project: AEP Pirkey

Boring/Well Name:______ SP-B3

Project Location:____ Hallsville, TX

Boring Date:__ 3/2/2020

Depth Scale Feet | Water Table | Soil Profile | Description | PID*

pp= pocket penetrometer

0

0.0'-0.4': Top soil, Black silt with vegetation

0.4'-0.7': Brown silt, moist, low cohesion

0.7'-2.0': Maroon and light gray silty clay, moderate stiffness (pp.2.5), moderate plasticity, iron ore/mottling present

2.0'-2.2': Brown silt, dry, brittle

2.2'-5.6': Maroon and ligh gray clay, high stiffness (pp. 4.0), low plasticity

5

5.6'-6.0': Orange silt, no cohesion, dry

6.0'-13.5': Maroon clay, high stiffness (pp >4.5), low plasticity; moist at 9'; wet at 12'

10

▼

13.5'-13.6': Brown/orange silt (iron ore), no cohesion

13.6'-17.5': Gray and orange clayey silt, good cohesion; iron ore present; wet

15

17.5'-20.2': Maroon and orange silty clay, low stiffness(pp. 0.5), moderate plasticity; iron ore present; wet

20

20.2'-21.1': Brown silt, no cohesion; wet

21.1'-22.7': Brown fine grained sand, well sorted; wet

22.7'-25.0': Maroon and orange silty clay, low stiffness (pp. 0.5), low plasticity; iron ore present; wet

25

30

Samples collected at 10-12'; 15-17'; 22-24'

TD at 25' bgs; refusal

*PID readings not collected

35

Drill Rig Geoprobe 3230 DT

Drilling Contractor:___ C&S

Driller:_ DJ Diduch

Geosyntec Consultants

Soil Boring Log

Project: AEP Pirkey

Boring/Well Name:______ SP-B4

Project Location:____ Hallsville, TX

Boring Date:__ 3/3/2020

Depth Scale Feet

Water Table

Soil Profile

Description

PID*

pp= pocket penetrometer

0.0'-0.4': Top soil, black silt, vegetation

0.4'-0.7': Brown clayey silt, good cohesion

0.7'-1.5': Red and light gray silty clay, moderate stiffness (pp. 2.5), high plasticity

1.5'-3.7': Maroon and light gray clay, high stiffness (pp. 4.5-5.0), low plasticity; iron ore present 3.1'-3.7'

3.7'-5.0': NO RECOVERY

5.0'-7.0': Maroon and light gray clay, high stiffness (pp. 4.5-5.0), low plasticity; iron ore present throughout

7.0'-8.0': Light gray clay with iron ore, moderate stiffness (pp.2.5-3.0), moderate plasticity

8.0'-10.0': Maroon clay, moderate stiffness (pp. 3.5), moderate plasticity; iron ore present; moist at 9'

10.0'-12.6': Maroon clay, moderate stiffness (pp. 3.5), moderate plasticity; iron ore present; wet at 12'

12.6'-13.3': Tan clay, low stiffness (pp.1.5), high plasticity; wet

13.3'-18.5': Tan and brown clayey silt, moderate cohesion; iron ore present; wet

18.5'-20.3': Maroon silty clay, low stiffness (pp. 1.0), moderate plasticity; iron ore; wet

20.3'-21.1': Dark gray/black clay, trace silt, low stiffness (pp. 1.5), high plasticity; wet

21.1'-21.3': Dark gray silt, good cohesion; wet

21.3'-21.9': Dark gray silty clay, low stiffness (pp. 1.5), high plasticity; wet

21.9'-22.3': Dark gray silt, moderate cohesion; wet

22.3'-22.7': light brown silt; low cohesion; wet

22.7'-24.4': Dark gray and dark green silty clay, moderate/high stiffness (pp.3.5), moderate plasticity; wet, glauconite present

24.4'-27.8': Dark green/gray fine grained sand, well sorted; wet; glauconite present

27.8'-30.0': Red and orange fine grained sand, well sorted, with iron ore; wet

Samples collected at 6-8'; 18-20'; 28-30'

TD at 30' bgs; refusal

*PID readings not collected

Drill Rig Geoprobe 3230 DT
Drilling Contractor:___ C&S
Driller:_ DJ Diduch

Geosyntec Consultants

Soil Boring Log

Project: AEP Pirkey

Boring/Well Name:______ SP-B5

Project Location:_____ Hallsville, TX

Boring Date:__ 3/5/2020

Depth Scale Feet	Water Table	Soil Profile Description		PID*
		pp= pocket penetrometer		
0		0.0'-0.6':	Top soil, black silt, vegetation	
		0.6'-0.9':	Brown clayey silt, good cohesion	
		0.9'-2.4':	Red and gray silty clay, moderate/high stiffness (pp. 3.5), high plasticity; iron ore present	
		2.4'-5.0':	NO RECOVERY	
5		5.0'-8.6':	Maroon and gray clay, moderate/high stiffness (pp. 3.5), low plasticity; iron ore present; moist	
	▼	8.6'-10.0':	Light gray and maroon clay, moderate/low stiffness (pp.2.0), high plasticity; iron ore present; wet	
10		10.0'-12.0':	Maroon and gray clay, high stiffness (pp. 4.0), moderate plasticity, iron ore present; wet	
		12.0'-12.9':	Iron ore with maroon clay, high stiffness (pp.4.0), moderate plasticity; wet	
		12.9'-15.0':	Maroon clay, high stiffness (pp.4.0), high plasticity; iron ore present; wet	
15		15.0'-18.4':	Light gray and orange clayey silt, good cohesion; iron ore present; wet	
		18.4'-18.6':	Dark maroon iron ore; wet	
		18.6'-20.0':	Orange and gray clayey silt, good cohesion; iron ore present; wet	
		20.0'-21.2':	Maroon and orange clayey silt, good cohesion; iron ore present; wet	
20		21.2'-22.3':	Black clay, trace silt, low stiffness (pp.1.0), high plasticity; wet	
		22.3'-22.6':	Black clay, high stiffness (pp.4.5), moderate plasticity	
		22.6'-22.9':	Black silt, no cohesion; wet	
		22.9'-23.4':	Black clay, trace silt, moderate stiffness (pp.2.5), high plasticity; wet	
		23.4'-25.0':	Dark gray and green fine grained sand; well sorted; wet; glauconite present	
25			Samples collected at 6-8'; 16-18'; 23-25' TD at 25' bgs; refusal *PID readings not collected	
30				
35				

Drill Rig Geoprobe 3230 DT
Drilling Contractor:___ C&S
Driller:_ DJ Diduch

Geosyntec Consultants

ATTACHMENT B

AD-22 Boring Log and Well Installation Diagram

APEX PROJECT NO.: 110-089 ☐ **BORING** **BORING NUMBER:** ______ ■ **MONITOR WELL** **MONITOR WELL NUMBER:** AD-22

FACILITY NAME: AEP- Pirkey Power Plant **FACILITY ID NO.:** N/A

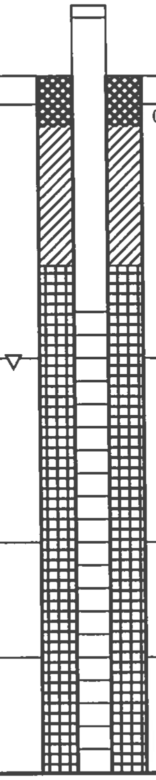
FACILITY ADDRESS: Hallsville, Texas

DRILLING COMPANY/METHOD/RIG: Apex Geoscience Inc. / Hollow-stem Augers/ CME-55 Track Rig

DRILLER: Ed Wilson, Apex Geoscience Inc. **COMPLETION DATE:** 12/16/2010

PREPARED BY: David Bedford **LOGGED BY:** David Bedford

LATTITUDE: N 32°27'03.3" Datum: WGS-84 **WELL LOCATION:** Triangle- South side Quansit Hut
LONGITUDE: W94°29'41.3"



DEPTH (FEET)	PID (PPM)	SAMPLE INTERVAL	WELL LOG AND COMPLETION DETAILS	USCS CODE	SOIL DESCRIPTION AND COMMENTS	Odor	Moisture
1			0-0.5	SC	Clayey sand, light brown, very fine grained	None	Moist
2			0.5-12	CL	Lean clay, light brown mottled with light gray	None	Slightly
3							Moist
4					Few iron ore (small) pebbles in clayey sandy streaks		
5							
6							
7							
8							
9							
10							
11							
12							
13			12-20	SC	Clayey sand, grayish brown with orangish brown streaks,	None	Slightly
14					very fine grained		Wet
15					Slightly wet @ 12.5' from seepage		
16					Large amount of iron ore 15-17'		
17							
18							
19					Very firm 18-18.5'		
20							
21			20-25	SC	(Dense crystalline rock 21-21.1'), light brown clayey sand,	None	Wet
22					greenish black, mica, black clay streaks, very fine grained,		
23					wet @ 20'		
24							
25							
26			25-30	SM	Sand, greenish brown (1') grading to orangish brown, silty,	None	Wet
27					very fine grained		
28							
29							
30							
31							
32					Boring Terminated at 30'		
33							
34							
35							
36							
37							
38							
39							
40							

▩ Cement ▨ Bentonite ▦ Filter Sand ▽ Water Level

Apex geoscience inc.

Total Depth: 30 feet
Filter Sand (Size/Interval): 8-30'
Grout (Type/Interval): Grout from 0-2'; Bentonite from 2-8'
Surface Completion ☐ Flush ■ Above Ground

Riser Interval: +3 (ags)-10'
Screen Interval: 10-30'
Water level: 12.5'
Above Ground 3'

Note: This log is not to be used separate from this report.

ATTACHMENT C

Certification by Qualified Professional Engineer

CERTIFICATION BY A QUALIFIED PROFESSIONAL ENGINEER

I certify that the selected and above described alternative source demonstration is appropriate for evaluating the groundwater monitoring data for the Pirkey FGD Stackout Area CCR management area and that the requirements of 40 CFR 257.95(g)(3)(ii) have been met.

BETH ANN GROSS
79864

Beth Ann Gross
Printed Name of Licensed Professional Engineer

Beth Ann Gross
Signature

Geosyntec Consultants
2039 Centre Pointe Blvd, Suite 103
Tallahassee, Florida 32308

Texas Registered Engineering Firm
No. F-1182

79864
License Number

Texas
Licensing State

4/2/2020
Date